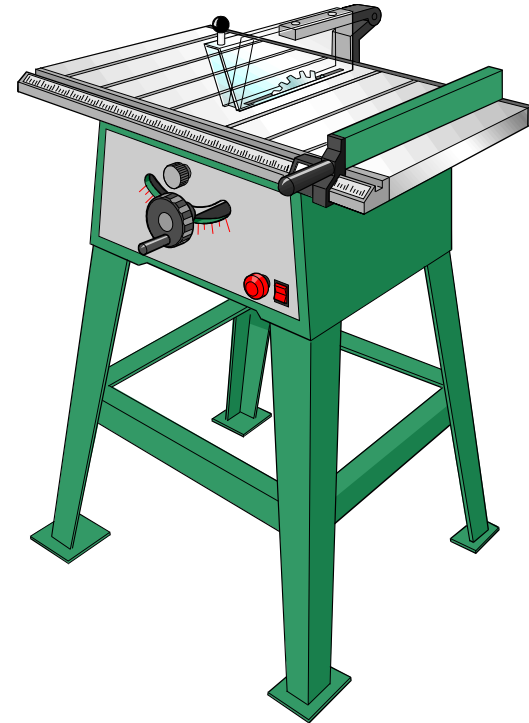


HOOR 6 - Machinery & Machine Guarding

- Basics of Machine Safeguarding
- Methods of Machine Safeguarding
- General Requirements
- Subsection Overview
- Safeguarding Checklist



Basics of Machine Safeguarding

Machine hazards can
cause:

Crushed hands & arms

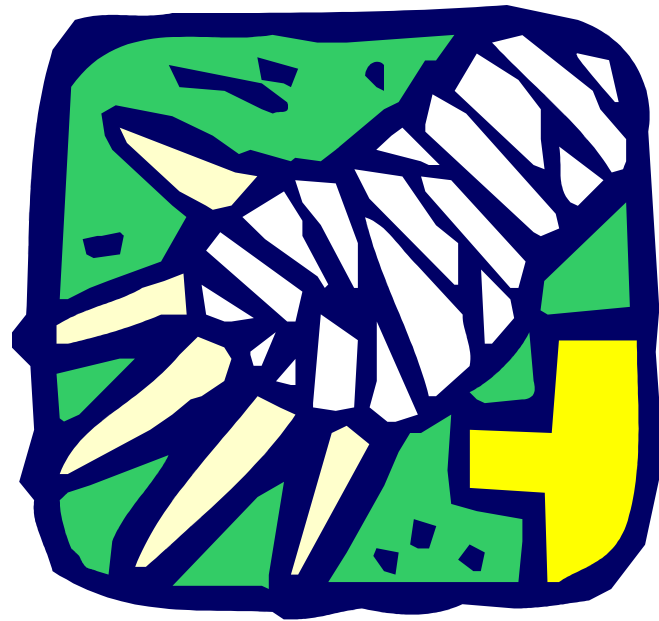
Severed fingers

Blindness

Lacerations

and

Death



A good rule to remember:

***Any machine part, function, or process which
may result in
injury must be safeguarded.***

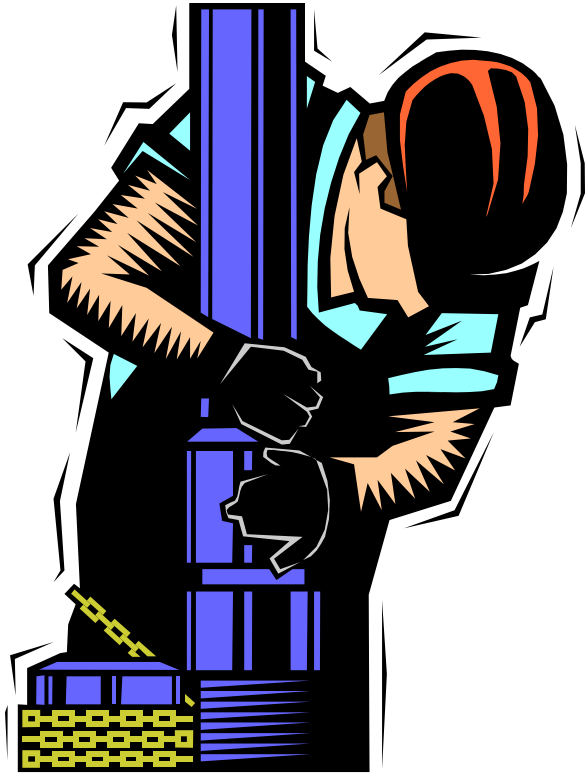
Where Mechanical Hazards Occur

3 Basic Areas Need Safeguarding:

- The “point of operation”
- Power transmission apparatus
- Other moving parts



Where Mechanical Hazards Occur



The “**point of operation**”
is where the work is
performed on a
material,
such as:

Cutting
Shaping
Boring
or
Forming of stock

Where Mechanical Hazards Occur

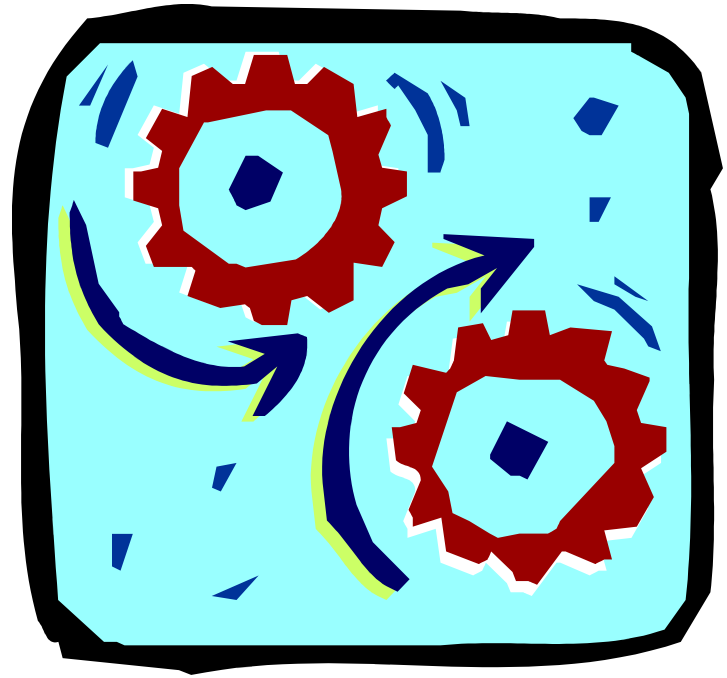
Power transmission apparatus is all components of the mechanical system which transmit energy to the part of the machine performing the work, i.e.,

Flywheels

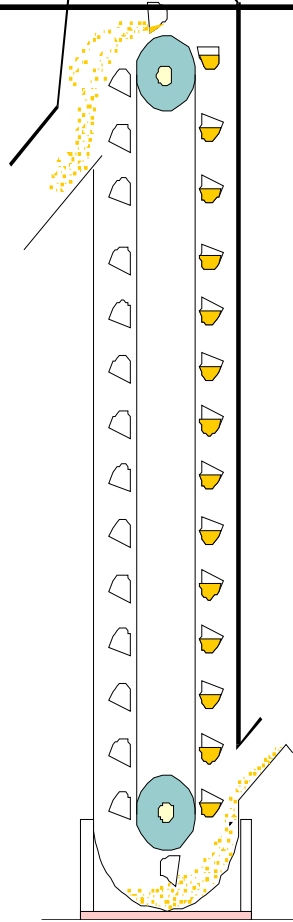
Pulleys

Belts

Couplings



Where Mechanical Hazards Occur



Other moving parts are all parts of the machine which move while the machine is working.

These can include reciprocating, rotating, and transverse moving parts, as well as feed mechanisms

Hazardous Mechanical **Motions** **& Actions**

Basic types are:

Motions: Rotating

Reciprocating

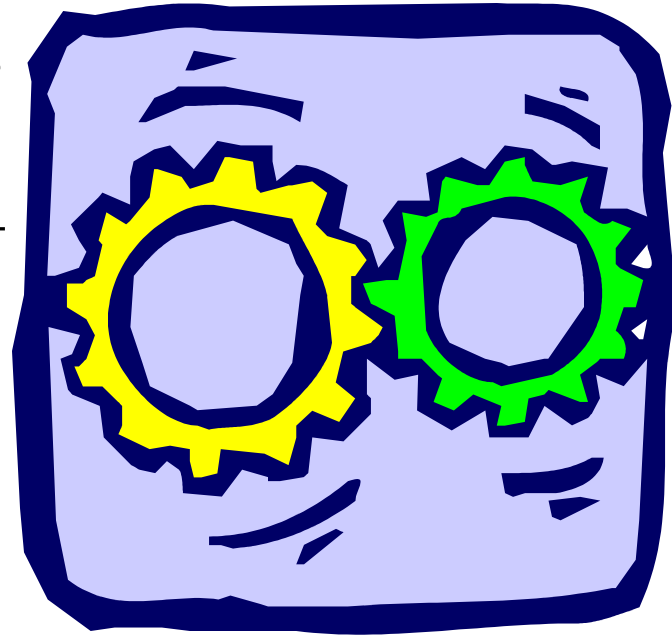
Transverse

Actions: Cutting
Punching
Shearing
Bending

Rotating Motion

- Can be dangerous
- Can grip clothing
- Can force limbs in to dangerous positions

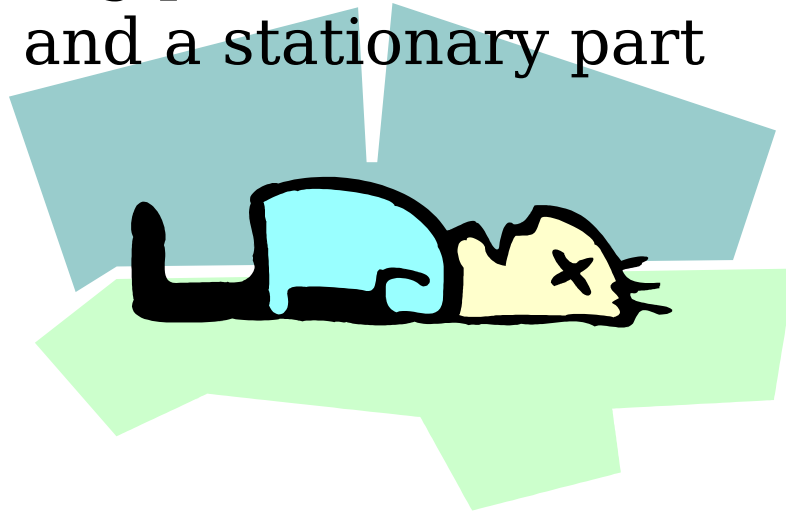
Injuries can be severe.



Collars, couplings, cams, clutches, flywheels, shaft ends, spindles, and horizontal or vertical shafting - all can be hazardous.

Reciprocating motions

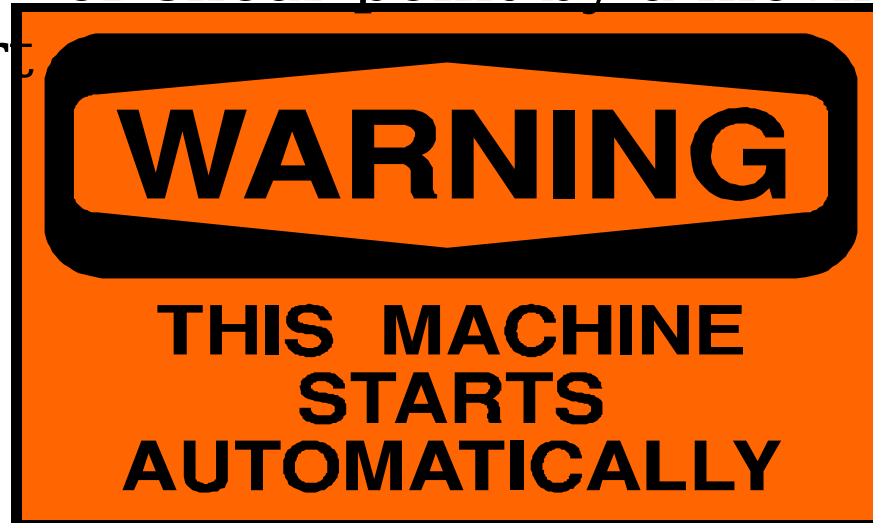
- Back-and-forth or up-and-down motion
- Worker can be caught between a moving part and a stationary part



Transverse motion

- Movement in a straight, continuous line
- Worker may be stuck or caught in a pinch or shear point by a moving

part



Requirements for Safeguards

Minimum general requirements:

- Prevent contact
- Be secure (tamperproof)
- Protect from falling objects
- Create no new hazards (no jagged edges, shear points)
- Create no interference
- Allow safe lubrication (without removing the guard)

Safeguard training should include:

- A description and identification of hazards that go with operating a particular machine
- What are the safeguards, how do they provide protection, and what are the hazards they prevent
- How the safeguards are used and why
- How, and under what circumstances, the safeguards can be removed - **and by whom**
- What to do if a safeguard is damaged, missing, or unable to provide adequate protection

Safeguard Training

Necessary for

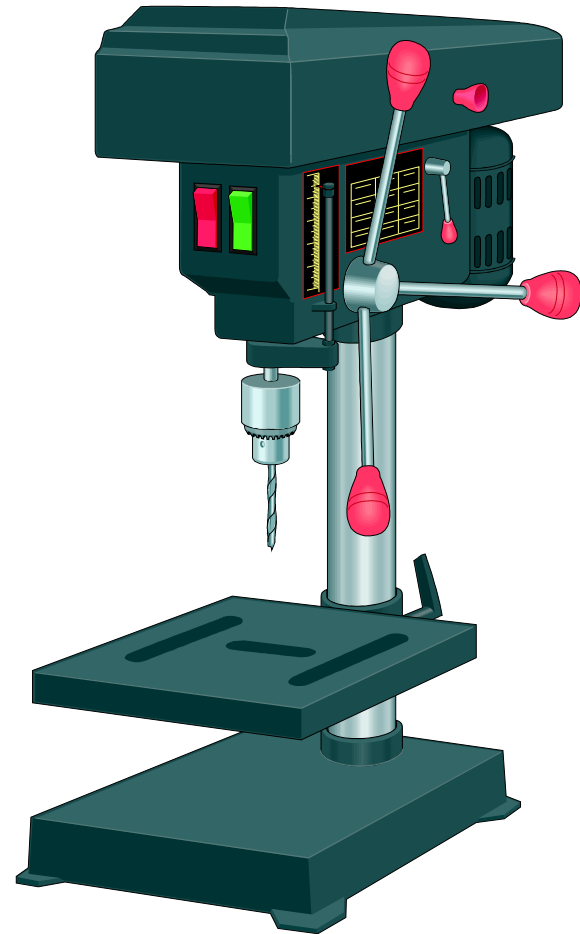
- New operators,
- Maintenance, and
- Set-up personnel
and
- All personnel operating or maintaining or setting up a machine when new or altered safeguards are put in service, or personnel are assigned to a new machine or operation



Methods of Machine Safeguarding

To determine the proper safeguarding method, determine:

- Type of operation
- Size & shape of stock
- Method of handling
- Physical layout of work area
- Type of Material
- Production requirements or limitations



Methods of Machine **Safeguarding**

- As a general rule, power transmission apparatus is best protected by fixed guards that enclose the danger area.
 - Safeguards are grouped under **5 general classifications:**
 - Guards
 - Location/Distance
 - Devices
 - Potential Feeding
 - Miscellaneous Aids
 - Ejection
- &
- Methods

Guards

- 4 types:

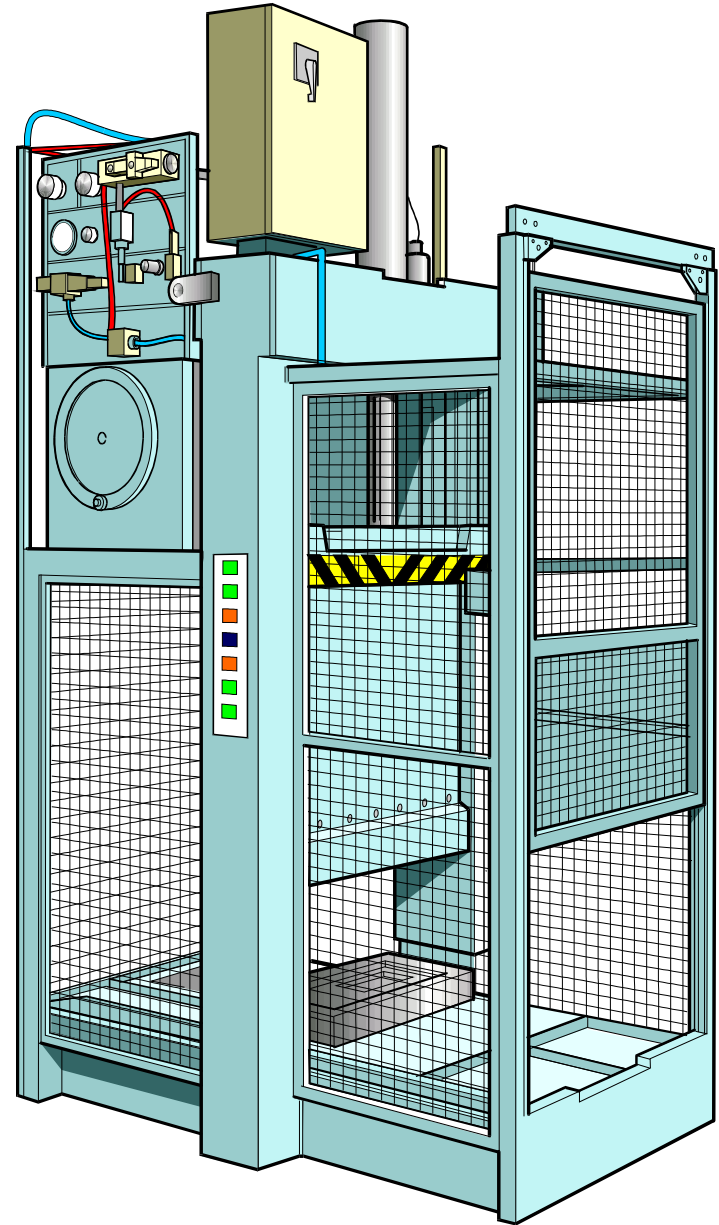
Fixed

Interlocked

Adjustable

Self-adjusting

Fixed



Fixed Guards

- A permanent part of the machine.
- Not dependent upon moving parts to perform its intended function.
- Constructed of material substantial enough to withstand whatever impact it may receive and to endure prolonged use.
- Usually preferable to all other types - relatively simple and permanent.

Interlocked Guards

- When opened or removed, tripping mechanism on this guard shuts off - or disengages - machine power until guard is put back in place.
- May be electrical, mechanical, hydraulic, pneumatic or any combination of these.

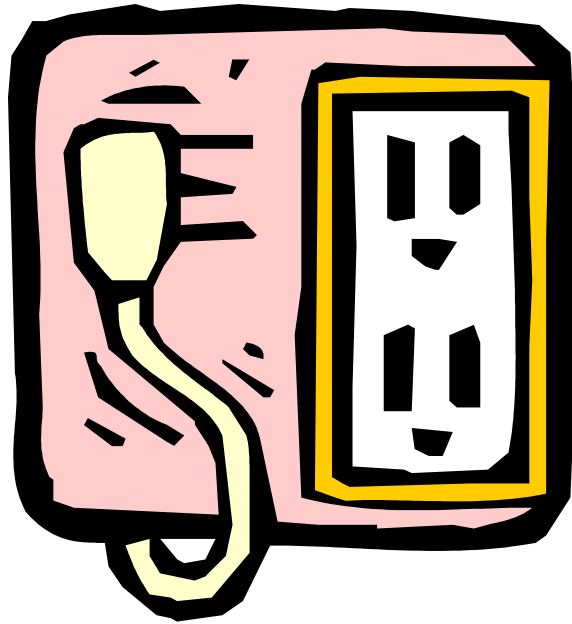
Adjustable Guards

- Allow flexibility in accommodating various sizes of stock being machined.

Self-Adjusting Guards

- As stock is moved through the machine, guard is pushed away, providing an opening only large enough for the stock to be machined.
- After stock is removed, guard returns to rest position.
- Protects operator by placing barrier between the danger area and the operator.
- Constructed of plastic, metal or other material.
- Offer different degrees of protection.

Devices



- Can perform several functions:
 - Stop machine automatically
 - Prevent access to danger areas
 - Provide barrier in sync with machine operating cycle to prevent access to danger area
- Types:
 - Presence-Sensing
 - Pullback
 - Restraint
 - Safety Trip Controls
 - Movable Gate

Presence-Sensing Devices

- Uses a system of light sources and controls to interrupt the machine's operating cycle.
- If light field is broken, machine stops.
- Use this device only on machines which can be stopped before the worker can reach the danger area.
- Devices include radio-frequency and electromechanical types.

Pullback Devices

- Use a series of cables attached to operator's hands, wrists, and/or arms.
- Primarily used on machines with stroking action.
- When slide/ram is up, operator has access to the point of operation; when slide/ram begins to descend, a mechanical linkage automatically assures withdrawal of the hands from the point of operation.

Restraint Devices

- Similar to Pullback device.
- Uses cables and straps to prevent travel to danger area (a predetermined safe area is set by process engineer that allows worker to get the job done without access to danger area).

Safety-Trip Control Devices

- Provides for quick deactivation of the machine in an emergency situation.
- Pressure-sensitive body bar deactivates machine when depressed.
- If operator trips, loses balance, or is drawn in to the machine, applying pressure to the bar stops the operation.
- Positioning the bar on the machine in the correct location is critical.

Movable Gate Guard

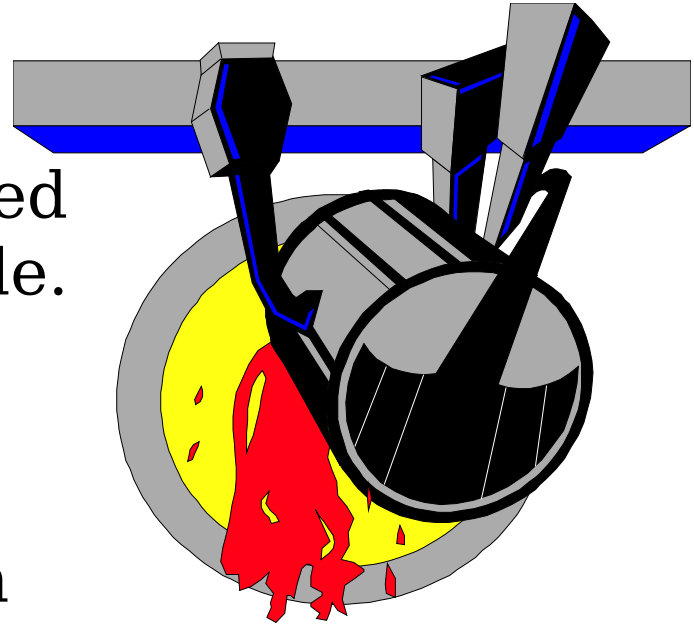
- The gate is a movable barrier that protects the operator at the point of operation before the machine cycle can be started.
- Gates can be designed to operate with each machine cycle (example, NC machine doors open automatically after a part is made)
- If gate does not close properly, machine does not start.

Safeguarding by Location/Distance

Machine or its dangerous moving parts is positioned so they are not accessible.

Accomplished by:

- * Building enclosures
- * Putting a wall between machine & operator
- * Designing a safe location for the machine to prevent access



Feeding & Ejection Methods to Improve Operator Safety

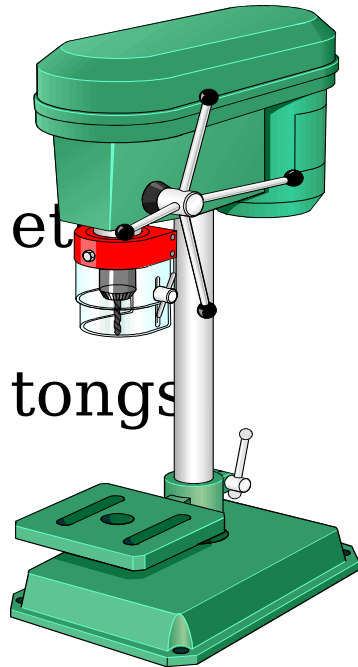
- These methods do not require operator to place hands in a danger area.
- In some cases, no operator involvement is necessary.
- Some methods create a new hazard (such as robotic arms swinging back and forth, etc.).
- Guards and devices must also be used when necessary to provide protection.

Feeding & Ejection Methods to Improve Operator Safety

- Types of feeding & ejection methods:
 - Automatic feed
 - Semi-automatic feed
 - Automatic ejection
 - Semi-automatic ejection
 - Robots

Miscellaneous Aids

- Do not provide complete protection, but may provide an extra margin of safety for the operator.
- Examples:



etc.)

Shields (around a drill, lathe,

Holding tools (to reach parts -

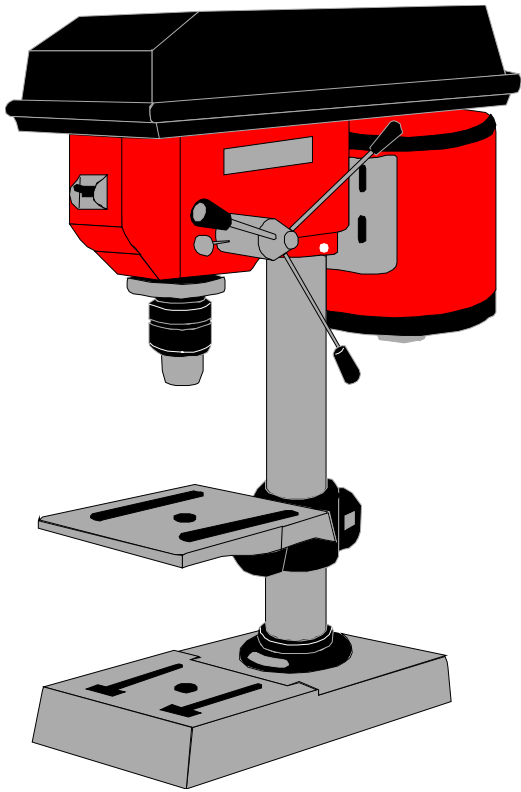
tongs
pliers, lifting devices, etc.)

Subpart O - Machinery & Machine Guarding

General Requirements for all Machines

- Employees in the machine area shall be protected from hazards by use of one or more methods of machine guarding (1910.212)
- Guards shall be affixed to the machine whenever possible and secured elsewhere if not possible
- The guard itself will not be an accident hazard

General Requirements for all Machines - 1910.212



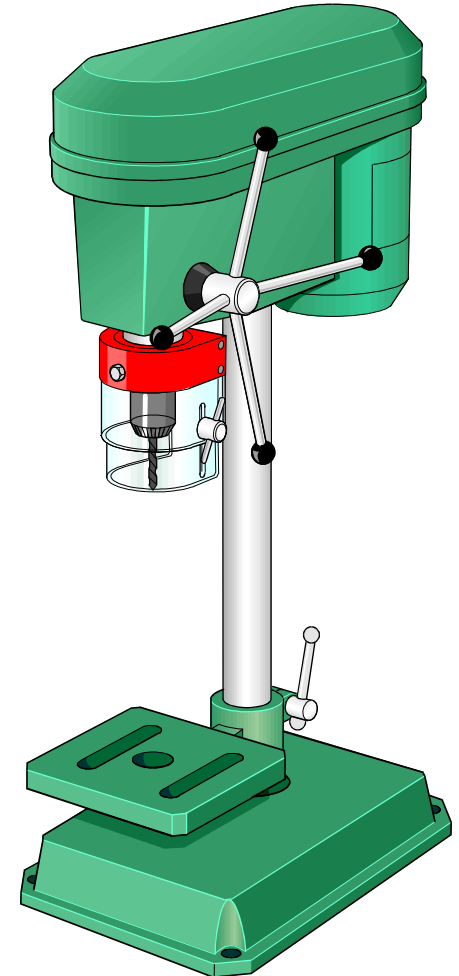
- The point of operation of a machine
whose operation exposes an employee
to injury shall be guarded
- Revolving drums, barrels & containers
shall be guarded by an enclosure
which is interlocked with the drive
mechanism
- When the periphery of the blades of a

General Requirements for all Machines - 1910.212

- Machines designed for a fixed location shall be securely anchored to prevent walking or moving

Section 1910.212 is a general (or horizontal)
standard that applies to all
machines not
specifically mentioned elsewhere
in other
sections of Subpart O.

The other sections in Subpart O apply
only



Other sections of **Subpart O**, Machinery &
Machine Guarding,
are:

-- 1910.212 - Definitions

-- 1910.213 - Woodworking Machinery

Requirements

-- 1910.214 - Cooperage Machinery

-- 1910.215 - Abrasive Wheel Machinery

-- 1910.216 - Mills & Calenders in the

Rubber &

Plastics Industries

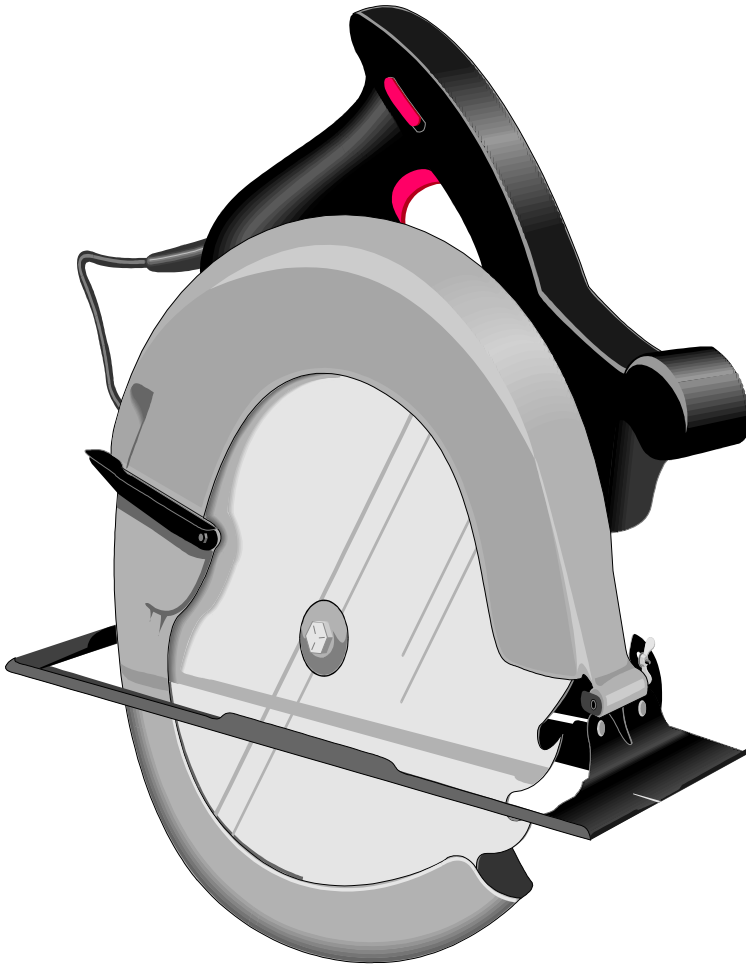
-- 1910.217 - Mechanical Power Presses

-- 1910.218 - Forging Machines

-- 1910.219 - Mechanical Power-

Transmission

Apparatus

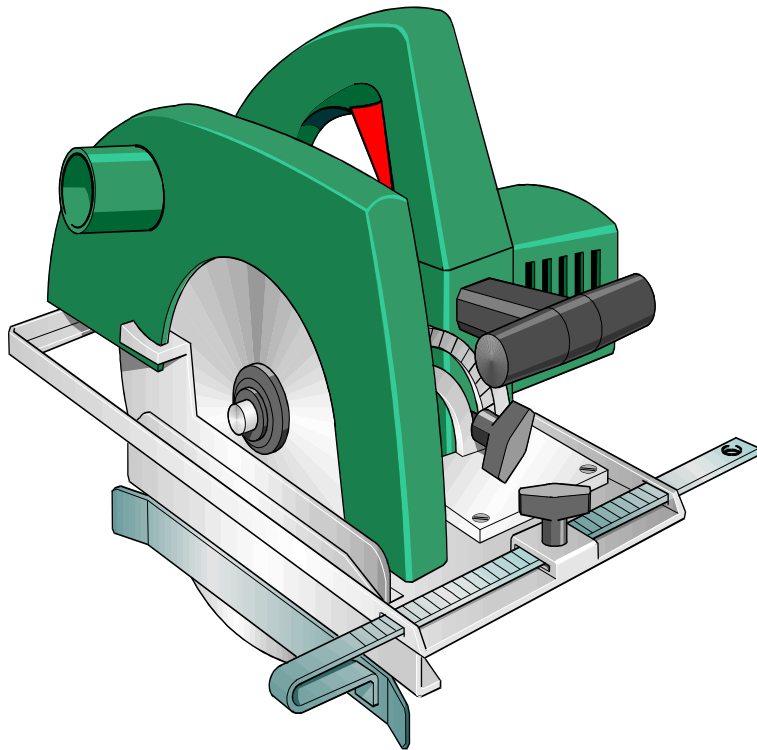


Another section of the
OSHA
1910 standard is closely
related to Subpart O --

Subpart P - *Hand and
Portable
Powered Tools and Other
Hand-
Held Equipment*

Subsection Overview

1910.213 - Woodworking Machinery Requirements



This section contains guarding requirements for 15 specific types of woodworking machines, including:

- Tables Saws
- Swing or Sliding Cut-Off Saws
- Radial Saws
- Band saws and Band Resaws

and others

Subsection Overview

1910.213 - Woodworking Machinery Requirements

- Each machine shall be constructed as to be free of excessive (able to be felt) vibration when the tool is mounted and run idle (no cutting load) at full speed.
- Operators must be able to cut off the power to the machine without leaving their position at the controls of operation (a mechanical or electrical power shut-off control shall be provided to make this possible).

Subsection Overview

1910.213 - Woodworking Machinery Requirements

- Where operator injury might result if motors restart after power failures, machines shall be prevented from automatically restarting when power is restored.
- Operators should not have to reach over cutters to get to the power and/or operating controls of the machine.
- All woodworking machinery shall be effectively guarded to protect the operator **and** other employees from hazards inherent to their operation.

Subsection Overview

1910.215 - Abrasive Wheel Machinery

Abrasive Wheel - defined:

... individual particles bonded together to form a wheel.

Where's the hazard?

If not properly mounted and used, the wheel can literally explode! Sections of the wheel may fly at high speeds and strike the operator .. causing death or serious injury.

Subsection Overview

1910.215 - Abrasive Wheel Machinery

- **4 general subsections:**

- General Requirements -
- Guarding
- Flanges -
- Mounting

Not covered by this section:

Natural sandstone wheels &
Metal, wooden, cloth or paper
discs, all

Subsection Overview

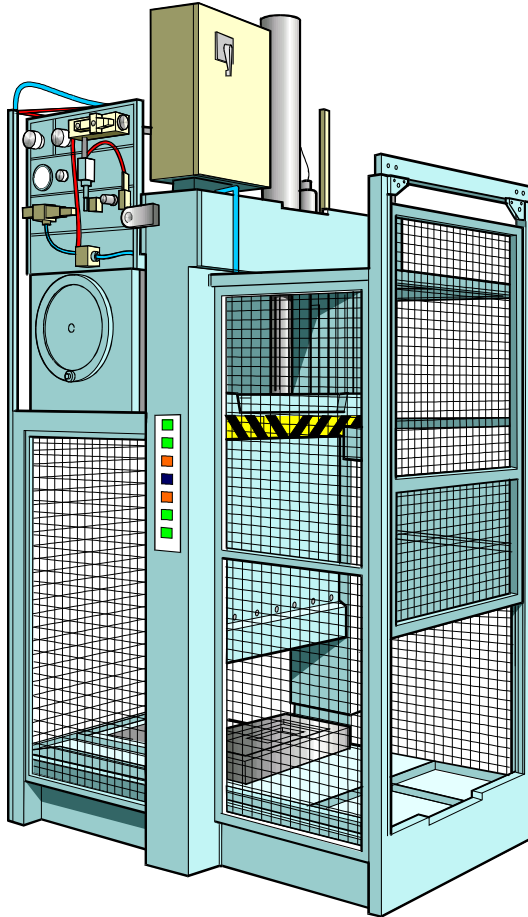
1910.215 - Abrasive Wheel Machinery

- Abrasive wheels shall be used only on machines provided with safety guards (with exceptions cited in 1910.215(a)(1)(i) through (iii)).
- Abrasive wheel safety guards shall cover the spindle nut, and flange projections (with exceptions cited in 1910.215(a)(2)(i) and (ii)).
- On offhand grinding machines, adjustable work rests of rigid construction shall be used to support the work.
 - Rests shall be adjusted closely to the wheel
 - Maximum opening is 1/8 inch

Subsection Overview

1910.217 - Mechanical Power Presses

Basic Rules



- Employer shall provide and ensure the use of point-of-operation guards - or properly applied and adjusted point-of-operation devices - to prevent the entry of hands or fingers into the point of operation on the machine

Subsection Overview

1910.217 - Mechanical

Power Presses

- A substantial guard shall be placed over the treadle on foot-operated presses.
- Pedal counterweights shall have the path of the travel of the weight enclosed.
- Full revolution clutch machines shall incorporate a single stroke mechanism (except where automatically fed in continuous operation and points of contact are

Subsection Overview

1910.217 - Mechanical Power Presses

- All point-of-operation injuries must be reported to OSHA or the state agency within 30 days.
- The employer shall train and instruct the operator in the safe method of work before starting work on any operation.
- Work areas will have ample clearance between machines (so the movement of one operator does not interfere with another).
- Ample room shall also be provided for cleaning machines, handling material, work pieces, and scrap.

Subsection Overview

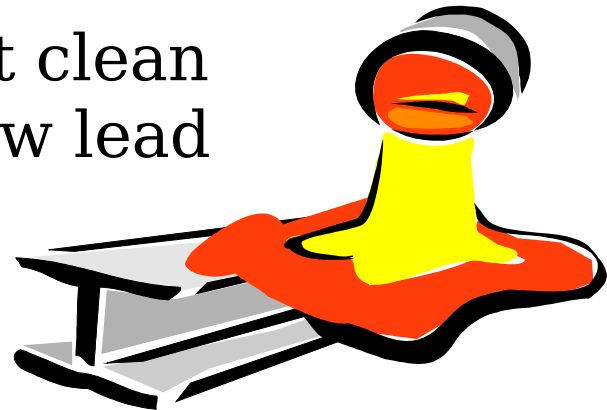
1910.217 - Mechanical Power Presses

- Each press shall be inspected and tested no less than weekly to determine the condition of the:
 - Clutch/brake mechanism
 - Anti-repeat feature
 - and
 - Single stroke mechanism.
- Necessary maintenance or repair - or both - shall be performed **and** completed **before** the press is operated

Subsection Overview

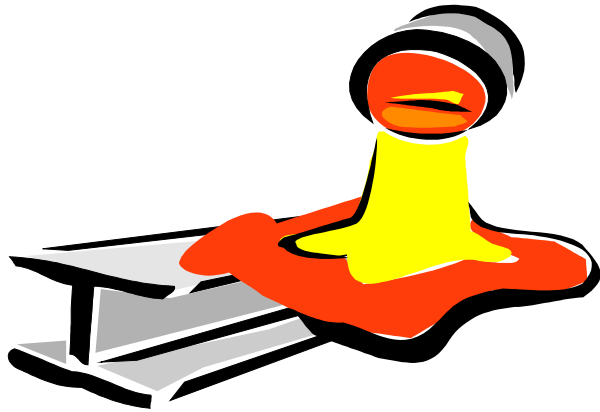
1910.218 - Forging Machines

- Thermostatic control of heating elements shall be provided to maintain proper melting temperature and prevent overheating
- Portable units shall be used only in areas where general room ventilation is provided
- PPE shall be worn
- Equipment shall be kept clean (particularly from yellow lead oxide)



Subsection Overview

1910.218 - Forging Machines



- The employer shall maintain all forge shop equipment in a condition which insures safe operation. **This includes**

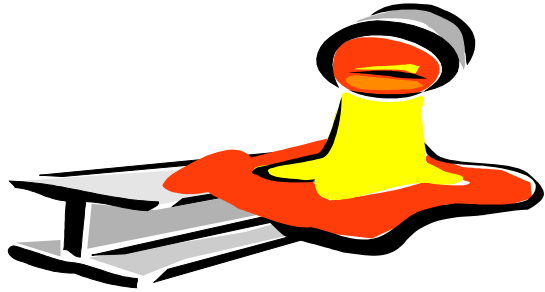
- Establishing periodic and regular maintenance safety checks and keeping certification records of these inspections
- Scheduling & recording the inspection of guard and point-of-operation protection devices at frequent and regular intervals

Subsection Overview

1910.218 - Forging Machines

- Training personnel in the proper inspection and maintenance of forging machinery & equipment
- Assuring all overhead parts are fastened or propped in such a manner that they will not fly off or fall in event of failure
- All hammers shall be positioned or installed in such a manner that they remain on or are anchored to foundations sufficient to support them (according to applicable engineering standards)

Subsection Overview



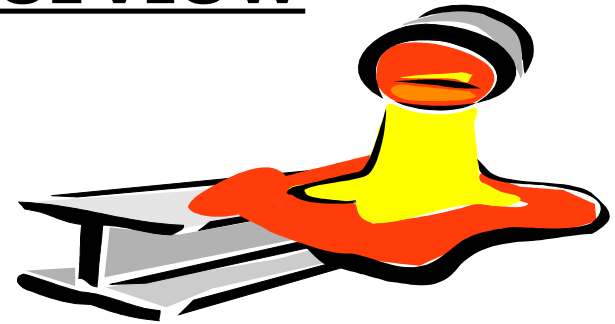
1910.218 - Forging Machine

Hammers and presses:

- Means shall be provided for disconnecting machine locking it out (or rendering cycling controls inoperative)
- The ram shall be blocked when dies are being changed or other work is done on the hammer
- Material handling equipment shall be of adequate size, and dimension to handle die-setting operations
- A scale guard shall be provided at the back of every hammer and press to stop flying scale

Subsection Overview

1910.218 - Forging Machines **Hammers, general:**



- All foot-operated devices (pedals, treadles, bars, valves, switches) shall be substantially and effectively protected from unintentional operation

Presses:

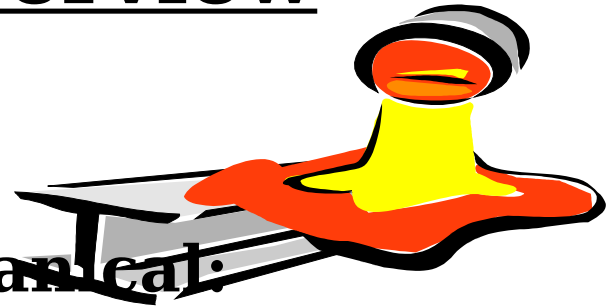
- All manually operated valves and switches shall be identified and readily accessible

Subsection Overview

1910.218 - Forging

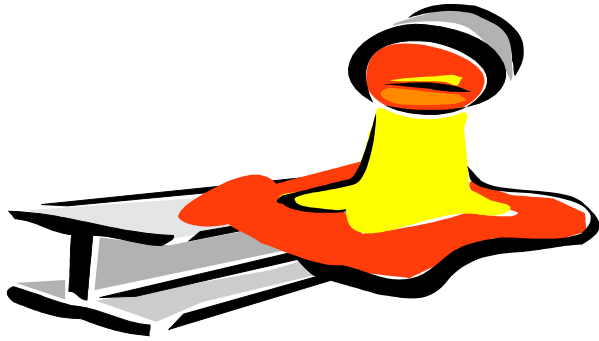
Machines

Forging Presses - Mechanical:



- When dies are being changed or maintenance is performed on the press:
 - Power shall be locked out
 - Flywheel shall be at rest
 - Ram shall be blocked (with a material the strength of which meets or exceeds specification/dimensional requirements in Table O-11 of 1910.218)

Subsection Overview



1910.218 - Forging Machine

Forging Presses - Hydraulic

- When dies are being changed or maintenance is performed on the press:
 - Hydraulic pumps and power apparatus shall be locked out
 - The ram shall be blocked with a material the strength of which shall meet or exceed the specifications or dimensions shown in Table O-11 of 1910.218

Subsection Overview

1910.218 - Forging Machines

Other specific requirements exist for:

- Power-driven hammers (1910.218(d))
- Gravity hammers (1910.218(e))
- Trimming presses (1910.218(g))
- Upsetters (1910.218(h))
- Other forging equipment (1910.218(i))
- Other forge facility equipment (1910.218(j))
(Billet shears, saws, conveyors,
shot blast and grinding machines)

Subsection Overview

1910.219 - Mechanical Power-Transmission Ap

Refers to all components of the mechanical system which transmit energy from the prime mover (power source) to the part of the machine performing the work.

Including: **Flywheels, pulleys, belts, connecting rods, shafting, couplings, cams, spindles, chains, cranks & gears**

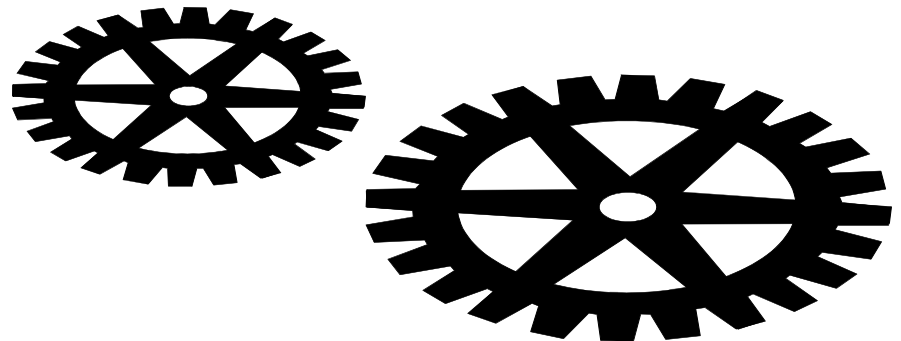


The primary thrust of this section is to ensure employees cannot be injured from being caught by

Subsection Overview

1910.219 - Mechanical Power-Transmission Apparatus

- Equipment guards shall be made of metal or other suitable material (wood guards may be used in wood making and chemical industries)
- Rotating and reciprocating parts (pulleys, belts, sprockets, chains, flywheels, etc.) - or any portion thereof - within 7 feet of the floor or working platform shall be effectively guarded
- Flywheels protruding through a working floor shall be guarded



Subsection Overview

1910.219 - Mechanical Power-Transmission Apparatus

- Types of apparatus covered by this section include:

Prime-mover guards

Pulleys

chain drives

Gears, sprockets & chains

Setscrews

couplings

Belt shifters, clutches,
guards

shippers, poles, perches
and fasteners

Shafting

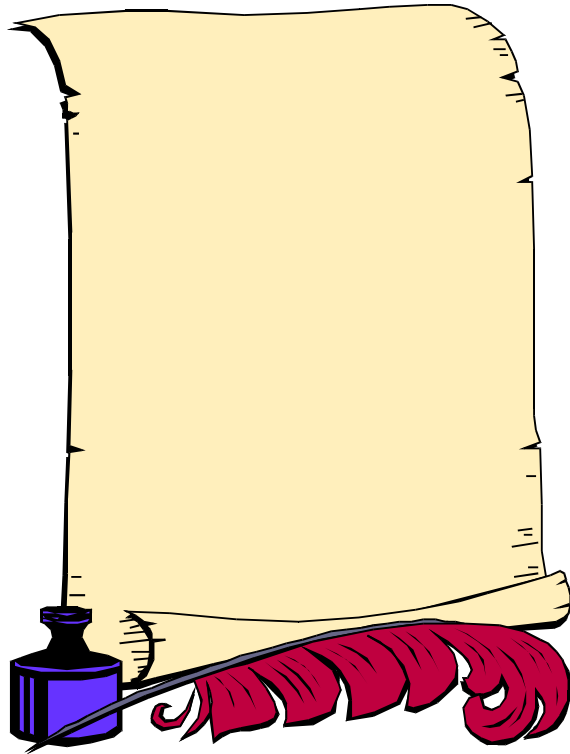
Belt, rope &

Keys

Collars &

Standard

- All power transmission equipment shall be



Safeguarding Checklist

Lockout/ Tag out

1910.147



This section requires employers to establish program and utilize procedures for affixing appropriate lockout devices or tag out devices to energy isolating devices, and to otherwise disable machines or equipment to prevent unexpected energy, start up, or release of stored energy in order to prevent injury to employees.

HOUR 6 QUIZ

training is necessary for

1. Any machine part, function, or process except:

which may result in injury must be safeguarded.

personnel

True _____ False _____

2. The **point of operation** is the supervisors

components of the mechanical system assigned to a new which transmit energy to the part of operation.

the machine performing the work.

True _____ False _____
equipment does

3. Safeguard training should include all equipment in a of the following except: condition.

a. How safeguards are used and why and recording the

b. When safeguards must be put in to

4. Safeguard

all of the following

a. New operators
b. Maintenance

c. Set-up personnel
d. Foreman
e. Department

f. Personnel

machine or

5. Use of forging

not require:

a. Maintaining

safe operating

b. Scheduling

inspection of

Hour 6 Quiz - Answers

- 1. True.
- 2. False. This is the “**power transmission apparatus**”.
- 3. B. Safeguards must be put in for the entire operation (not at stages of it).
- 4. E.
- 5. B. Only guards & point-of-operation protection devices must be inspected.